Studies on Victorian bryophytes 5. Key to leafy liverworts

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Abstract
A new key to the genera and many species of leafy liverworts in Victoria is provided. (*The Victorian Naturalist* **123** (4), 2006, 236-247)

Introduction

In the mid 1970s George Scott produced the first key to Victorian liverworts, mainly for botany students at Monash University (Scott 1975). He later expanded this key for his *magnum opus* on southern Australian liverworts (Scott 1985), providing botanists for the first time with an authoritative key for identifying our hepatic flora.

In the time since that publication, many additions, deletions and renamings of species have occurred. This new key is based on Dr Scott's original keys, but includes new genera and new names for existing genera. Allowance is also made for common errors, especially with characters that may be variable or difficult to distinguish. Thallose liverworts with a leafy form are included in the key for completeness.

Although this is mainly a key to genera, many couplets lead to a single species, and Group B is keyed to species throughout. Full keys to species in various genera will be published progressively in later papers in this *Studies* series. In the meantime, the treatments of genera in Scott (1985) are still more than adequate.

In using this key, keep in mind that our knowledge of the Victorian bryophyte flora is still very incomplete, and species and genera presently known only from Tasmania, New Zealand or other parts of the world might still be found here. The key is also valid for South Australia and southern Western Australia and for most genera encountered in Tasmania and New South Wales.

Of the taxa in this key, only *Andrewsianthus cuspidatus* and *Triandrophyllum subtrifidum* are not described or illustrated in Scott (1985) or Meagher and Fuhrer (2003). Both are well illustrated in Schuster (2002).

Names of taxa follow the current national checklist (McCarthy 2006).

A basic glossary of terms used in this key, and in the key to thallose liverworts and hornworts (*Studies* 6) that follows, is included at the end of this paper. For a complete and beautifully illustrated glossary of bryological terms, see Malcolm and Malcolm (2000).

Key to groups

1 Leaves complicate-bilobed; folded, keeled, or with an inflated ventral sac .. **Group A**
Leaves not complicate-bilobed 2

2 Leaves densely hairy or ciliate, the leaf lamina hard to distinguish ..... **Group B**
Leaves ciliate or not, but lamina always easily distinguished 3

3 Underleaves absent or not visible..... **Group C**
Underleaves present 4

4 Leaves inserted incubously on stem; i.e. when viewed from the dorsal side, each leaf overlaps one closer to the shoot apex (or would do so if they were close enough) ..... **Group D**
Leaves inserted succubously, i.e. when viewed from the dorsal side, each leaf overlaps one farther from the shoot apex (or would do so if they were close enough); or inserted transversely 5

5 Leaves without lobes or marginal teeth ..... **Group E**
Leaves with 2 or more lobes, or with marginal teeth ..... **Group F**

Group A
Leafy liverworts with complicate-bilobed leaves

1 Leaves with a keel running longitudinally along the leaf; lobules absent 2
Leaves not keeled; lobules present 3

2 Underleaves present ..... ***Schistochila lehmanniana***
Underleaves absent ..... ***Paraschistochila tuloides***

3 Lobule dorsal 4
Lobule ventral 6

4 Plants thick, fleshy, brittle, bright green ..... ***Treubia tasmanica***
Plants delicate, not at all fleshy, dull green to yellow, often tinged chestnut 5

5 Underleaves present ..... ***Balantiopsis***
Underleaves absent ..... ***Diplophyllum***

6 Underleaves (as well as leaves) with saccate lobules ..... ***Heteroscyphus cymbaliferus***
Underleaves without saccate lobules 7

7 Lobules complex, forming an inflated claw or sac, very narrowly connected to the stem 8
Lobules simple, consisting of the inrolled or folded ventral margin of the leaf, inflated or not, usually widely connected to stem 9

8 More than 1 lobule per leaf ..... ***Gackstroemia weindorferi***
Only 1 lobule per leaf ..... ***Frullania***

9 Underleaves absent 10
Underleaves present 11

10 Rhizoids absent or arising from lobules; habitats various, rarely if ever epiphyllous ..... ***Radula***
Rhizoids in bundles on stem in the position of missing underleaves; mainly epiphyllous plants on leaves in rainforest ..... ***Cololejeunea***

11 Underleaves entire ..... ***Acrolejeunea securifolia***
Underleaves lobed or shallowly notched at apex 12

12 Lobule an inflated sac, appearing to be unattached to leaf 13
Lobule formed by a simple rolling or folding of the ventral leaf margin 14

13 Leaves with long, ciliate marginal teeth, at least in part^ ... ***Gackstroemia weindorferi***
Leaves entire ..... ***Frullania***

14 One underleaf for each lateral leaf 15
One underleaf for each pair of lateral leaves 16

15 Cells with high papillae ..... ***Colura***
Cells mamillose, never papillose ..... ***Diplasiolejeunea plicatiloba***

16 Leaves very narrow at base, attached to stem by 1 or 2 cells 17
Leaves widely attached to stem, by several cells 18

17 Leaf apex rounded; lobule with 3–4 teeth ..... ***Siphonolejeunea nudipes***
Leaf apex pointed; lobule with 1 tooth ..... ***Nephelolejeunea hamata***

18 Oil bodies 1 or 2 per cell, each resembling a cluster of grapes; apical tooth of lobule ± at right angles to stem; hyaline papilla on inner side of apical tooth of lobule ..... ***Cheilolejeunea mimosa***
Oil bodies several per cell, not grape-cluster type; apical tooth of lobule ± parallel to stem; hyaline papilla on outer side of apical tooth of lobule 19

19 Leaf base with 1 or 2 enlarged cells, each almost filled by an oil body ..... ***Harpalejeunea latitans***
Leaf base without such cells ..... ***Lejeunea***

Group B
Leafy liverworts with densely hairy or spiny leaves

1 Lobules present, either dorsally or ventrally 2
Lobules absent 4

2 Small, helmet-shaped ventral lobules present ..... ***Gackstroemia weindorfei***
Ventral lobules not present 3

3 Lobule formed by keeling of leaf ..... ***Schistochila lehmanniana***
Lobule formed by folding of leaf margin ..... ***Balantiopsis diplophylla***

4 Leaves with long, single-celled spines bent ± parallel to stem, pointing to the stem apex ..... ***Psiloclada claudestina***
Leaves not as above (if spines pointing to the apex, then not single-celled) 5

5 Leaves almost wholly divided into lobes and hairs, so that leaf lamina is not evident; stems with paraphyllia 6
Leaf lamina evident, although bordered by hairs or spines; paraphyllia absent 7

6 Cilia of leaves distinctly papillose; in dry sclerophyll forest ..... ***Trichocolea rigida***
Cilia of leaves not papillose; in wet forest or rainforest ..... ***Trichocolea mollissima***

7 Hairs 1-celled, bristle-like; plant of dry heathland or woodland ..... ***Chaetophyllopsis whiteleggei***
Hairs many-celled; plants of dry to wet sclerophyll forest or rainforest 8

8 Shoots bipinnate, at least in widest part of plant; leaf hairs 1 cell wide at base ..... ***Telaranea pulcherrima* var. *mooreana***
Shoots simple or 1-pinnate; leaf hairs several to many cells wide at base 9

9 Shoots long, fawn to yellow, epiphytic in wet forest or other cool, moist habitats; leaves bifid, each lobe also bifid, the tips extended into hyaline hairs ..... ***Lepicolea scolopendra***
Shoots and leaves not as above 10

10 Shoots distinctly golden brown, terrestrial on clayey soil ..... ***Temnoma townrowii***
Shoots yellow-brown to yellow-green, epiphytic on trees and rotting wood* ..... ***Lepidozia ulothrix***

* Most specimens keying to here will be *Lepidozia ultothrix*, but another species resesmbling *L. hirta* of New Zealand is present in Victoria. *L. ulothrix* often has the lobes further divided; the other species does not.

Group C
Leafy liverworts without underleaves, or underleaves not apparent

1 Leaves with a ventral lobule 2
Leaves without a ventral lobule 3

2 Rhizoids absent or arising from lobules; habitats various, rarely epiphyllous ..... ***Radula***
Rhizoids in bundles on stem in the position of missing underleaves; often epiphyllous ..... ***Cololejeunea***

3 Although appearing leafy and lettuce-like, plant thallose, without a clearly defined stem 4
Plants truly leafy, leaves arising from a clearly defined narrow stem (stem may be obscured by leaves) 5

4 Rhizoids hyaline or brown, never crimson; thallus a wide rosette up to 20 mm in diameter, the lobe ruffled and lamellate on dorsal surface; mature capsule enclosed in a bulbous central involucre ..... ***Petalophyllum preissii***
Rhizoids usually crimson; thallus not lamellate; mature capsule raised on translucent stalk ..... ***Fossombronia/Austrofossombronia***

5 Leaves with lobes, teeth or spine-like hairs 6
Leaves rounded, entire or crenulate, or tapering to a single sharp point 22

6 Margins of leaves with 2 or more slender spine-like hairs 7
Margins of leaves without teeth, or teeth broad at base, not spine-like 9

7 Plants terrestrial, clearly anchored to the soil by rhizoids along the length of the stem ..... ***Goebelobryum unguiculatum***
Plants terrestrial or not, but if so then without rhizoids, or rhizoids confined to stem base 8

8 Margins of leaves with 2 widely spaced ± parallel spines, swept backwards ..... ***Adelanthus bisetulus***
Margins of leaves with many short teeth ..... ***Plagiochila***

9 Plants densely papillose over stems and leaves 10
Plants papillose or not, but papillae not on stems 11

10 Stems hairy with short, stiff, papillose bristles; shoots 2–3 mm wide ..... ***Marsupidium setulosum***
Stems papillose but lacking bristles; shoots mostly less than 1 mm wide ..... ***Acrobolbus cinerascens***

11 Plants minute, thread-like, prostrate or erect, almost invisible to the naked eye; leaves bilobed, sometimes also toothed (seee couplet 4 Group F) ..... ***Cephaloziella***
Plants small to large, shoots easily visible to the naked eye; leaves variously lobed or toothed 12

12 Oil bodies conspicuous, dark brown in transmitted light 13
Oil bodies often inconspicuous, not dark brown (usually transparent) 14

13 Outer cells of stem similar to inner cells; marsupium at base of stem ..... ***Marsupidium surculosum***
Outer cells of stem small and thick-walled, forming a distinct 2–3-layered cortex; marsupium at the shoot tip ..... ***Tylimanthus***

14 Leaves with more than 2 lobes or teeth 15
Leaves bilobed or with 2 large apical teeth, otherwise with entire margins 17

Group C cont'd
Leafy liverworts without underleaves, or underleaves not apparent

15 Stems green or brown[\] ..... ***Plagiochila***
Stems black **16**

16 Shoot tips often curved over like a walking stick; leaves opposite, finely toothed ± all round margin; leaf cells without trigones ..... ***Calyptrocolea falcata***
Shoots tips erect; leaves alternating along stem, coarsely toothed or lobed along apical margin; leaf cells with very large trigones ..... ***Acrochila biserialis***

17 Leaves tightly and evenly pressed against stem **18**
Leaves spreading from stem, at least in one direction **19**

18 Plants greyish; leaves obvious, overlapping; stem hidden by leaves; on soil ..... ***Gymnomitrion incompletum***
Plants very dark green to black, appearing leafless but with minute widely spaced leaves; stem clearly visible; on rocks in flowing water ..... ***Cephalomitrion aterrimum***

19 Leaves bifid to halfway; plant aquatic or semi-aquatic ..... ***Allisoniella nigra***
Leaves bifid but never to halfway; plant not aquatic or semi-aquatic **20**

20 Leaves wrapped around stem; epiphytic in wet forest or rainforest ..... ***Anastrophyllum schismoides***
Leaves spreading widely from the stem; not epiphytic **21**

21 Leaves longer than wide, ± oblong; on soil at low elevations[^] ..... ***Andrewsianthus cuspidatus***
Leaves wider than long, ± oval, on rock at higher elevations .. ***Marsupella sparsifolia***

22 Shoots prostrate, with many rhizoids along much of the stem **23**
Shoots erect or ascending, attached to the substrate only at the base **31**

23 Leaves with papillose cuticle, at least in lower half of leaf..... **24**
Leaves smooth or striolate, never papillose **26**

24 Epiphytic in wet forest or rainforest, or on rocks in subalpine to alpine areas; capsule developing in perianth ..... ***Jamiesoniella colorata***
On soil in drier habitats (rarely aquatic); not in alpine areas; capsule in a buried marsupium **25**

25 Plants yellowish to deep green, sometimes tinted chestnut; oil bodies large, brownish, few per cell; leaf cuticle papillose only towards apex ..... ***Lethocolea pansa***
Plants silvery white to whitish green, not tinted chestnut; oil bodies small, colourless, up to 14 per cell; leaf cuticle usually papillose all over ..... ***Gongylanthus scariosus***

26 Leaves ± opaque, cells almost filled by brownish oil bodies ... ***Acrobolbus concinnus***
Leaves translucent, oil bodies pale (brownish only in *Lethocolea pansa*) **27**

27 Plants minute; leaf and stem cells all similar, bulging; leaves few-celled ..... ***Zoopsis***
Plants small to large, leaf and stem cells not bulging, leaf cells distinctly different from stem cells; leaves many-celled **28**

28 Leaves tongue-shaped, ending in an acute point ..... ***Cuspidatula monodon***
Leaves with widely rounded apex, not at all pointed **29**

29 Leaf insertion succubous, orientation ± longitudinal; leaves ± flat; epiphytic in rainforest or subalpine woodland[#] ..... ***Pedinophyllum monoicum***
Leaf insertion ± transverse; leaves flat to concave; terrestrial or aquatic **30**

Group C cont'd

Leafy liverworts without underleaves, or underleaves not apparent

30 Outer cells of stem enlarged and translucent, forming a distinct hyaloderm; leaves 2–3 cells thick in middle near the base; stolon-like stems present; plants of subalpine and alpine areas .. ***Hygrolembidium acrocladum***
Outer cells of stem not differentiated as a hyaloderm; leaves 1 cell thick throughout; stolon-like stems not present; plants in various habitats ..... ***Solenostoma* (*Jungermannia*)**

31 Leaves tightly and evenly appressed to stem **32**
Leaves spreading from stem, at least in one direction **33**

32 Cells of leaf margin thick-walled, with peg-like projections; leaves densely papillose, especially in basal half ..... ***Nothogymnomitrion erosum***
Cells of leaf margin thin-walled; leaves smooth or finely striate, not papillose ..... ***Herzogobrynm teres***

33 Erect branches arising from creeping stolon-like stems; plants small, leaves deeply concave; in subalpine or alpine areas ..... ***Hygrolembidium acrocladum***
Stolon-like stems not present; leaves concave or not, but never deeply; habitats various **34**

34 Stems mostly erect and unbranched, forming low dense turf on soil; capsule formed in tubular perianth, or in a marsupium **35**
Stems usually branched, not forming low dense turf; capsule formed in tubular or flattened perianth **37**

35 Male and female branches at end of shoot; oil bodies always pale ..... ***Solenostoma* (*Jungermannia*)**
White male branches and marsupia carried at base of stem; oil bodies clear brown, rarely pale **36**

36 Plants green, robust; leaves 1–2 mm wide; leaf cells without trigones ..... ***Marsupidium succulosum***
Plants usually brownish, small; leaves < 1 mm wide; leaf cells with distinct trigones ..... ***Jackiella curvata***

37 Leaves dark green, brown or black, margins entire; in montane to alpine areas in or next to water ..... ***Cryptochila grandiflora***
Leaves yellowish, green or greenish brown, margins usually toothed; in various habitats but mostly montane or lower ..... ***Plagiochila***

[A] Species of *Lophozia*, a genus not yet formally reported for Victoria but undoubtedly present here, could key out at couplet 16 or 22.

[B] *Jamesoniella tasmanica*, doubtfully recorded for Victoria, would key to here. It has yellowish or brown concave leaves and the perianth tapers to a narrow mouth; *Pedinophyllum monoicum* is always green and the perianth expands to a wide mouth.

Group D
Leafy liverworts with underleaves and incubous leaves

1 Leaves with ventral lobules ..... **Group A**
Leaves without ventral lobules **2**

2 Most leaves on main stems 4-lobed **3**
Most leaves on main stems 3-lobed, 2-lobed or not lobed **5**

3 Leaves inserted almost longitudinally; leaf cells in regular rows ..... ***Telaranea centipes***
Leaves clearly incubous to transverse; leaf cells not in regular rows **4**

4 Leaves nearly transverse; tiny plants creeping over clay soil, often in dense mats ..... ***Kurzia***
Leaves clearly incubous, leaves densely overlapping on most parts of shoot ..... ***Lepidozia***

5 Leaves divided almost to the base, each lobe consisting ± of 4–6 elongated cells in a row ..... ***Paracromastigum longiscypha***
Leaves not divided almost to the base, segments not as above **6**

6 Ventral flagella absent **7**
Ventral flagella present **9**

7 Leaves constantly 3-lobed, never with extra teeth; underleaves minute, entire to shallowly 3-lobed; plant minute ..... ***Drucella integristipula***
At least some leaves 2-lobed or entire; underleaves large, distinctly 2-lobed or 3-lobed; plants small to large **8**

8 Both leaves and underleaves variably and deeply 2-lobed and 3-lobed; leaf insertion clearly incubous; leaf surface distinctly striolate ..... ***Triandrophyllum subtrifidum***
Leaves and underleaves shallowly 2-lobed or entire, sometimes with small accessory teeth, never 3-lobed; leaf insertion ± transverse; leaf surface not striolate (but may be papillose) ..... ***Isotachis***

9 At least some leaves 3-lobed; ventral flagellum arising from axil of underleaf ..... ***Bazzania***
All leaves 2-lobed or entire; ventral flagellum replacing half of underleaf ..... ***Acromastigum***

Group E
Leafy liverworts with underleaves and succubous to transverse leaves without lobes

1 Leaves with a lobule on the ventral side ..... **Group A**
Leaves without a lobule on the ventral side 2

2 Plants minute, cells inflated and glistening; leaves consisting of a few relictual cells topped by smaller oblique cells ..... ***Zoopsis***
Plants small to large, cells not inflated and glistening; leaves consisting of many cells 3

3 Although appearing entire, apex of leaves with 2 small closely spaced lobes ..... ***Saccogynidium decurvum***
Leaves without lobes 4

4 Leaves deeply concave, more or less fleshy; in alpine habitats ..... ***Hygroleucbidium acrocladum***
Leaves not deeply concave, never fleshy; in various habitats 5

5 Plants somewhat to distinctly dorso-ventrally flattened; with brownish pigments; perianths ± laterally compressed, basically 2-lipped, the ventral lobe much reduced in length; rhizoids not confined to underleaf bases ..... ***Leptoscyphus expansus***
Plants usually lacking brownish pigments; perianth trigonous to trigonous inflated, the mouth equally or subequally trilobed; rhizoids confined to underleaf bases 6

6 Underleaves always joined to leaves on both sides, usually strongly; sex organs always on short specialised intercalary shoots; androecia on narrow leafless branches; leaf cells often with large trigones ..... ***Heteroscyphus***
Underleaves joined to leaves on 1 side only, or weakly joined to leaves on both sides; sex organs all or mostly on unspecialised leafy shoots; androecia usually on leafy branches; leaf cells without trigones, or trigones small to medium, never large 7

7 Plants stoloniferous; leaves transverse to succubous; leafy branches erect, without flagella* ..... ***Hepatostolonophora paucistipula***
Plants not stoloniferous, leaves succubous; leafy branches usually prostrate 8

8 Leaves with irregular fragile teeth on margin, often broken off, giving leaves a ragged appearance; cuticle with a distinct rainbow sheen ..... ***Leptoplyllopsis laxa***
Leaves without such marginal teeth; cuticle without a distinct rainbow sheen 9

9 Leaves moderately to deeply concave; underleaves plane, convex, or cucullate ..... ***Clastnatocolea***
Leaves plane or convex; underleaves sometimes strongly concave, especially near shoot apices ..... ***Chiloscyphus***

* I have found no legitimate material of *H. rotata* from Victoria, and therefore discount it at present from the Victorian flora. It has symmetrical leaves with recurved margins,and might well turn up in subalpine and alpine areas.

Group F
Leafy liverworts with underleaves and lobed or toothed succubous to transverse leaves

1 Leaves densely hairy or spiny, leaf lamina hard to distinguish ..... **Group B**
Leaves not densely hairy or spiny, leaf lamina clearly visible 2

2 Plants minute; leaves consisting of a few cells topped by smaller oblique cells ..... ***Zoopsis***
Plants minute to large; leaves consisting of many cells 3

3 Plants minute, thread-like; leaves hardly visible under hand lens; underleaves minute or absent 4
Plants small to large, not thread-like, leaves clearly visibly under hand lens; underleaves always present 5

4 Leaf margins entire ..... ***Cephaloziella exiliflora***
Leaf margins raggedly toothed ..... ***Cephaloziella hirta***

5 Stems dark, densely covered in pale hair-like paraphylls; leaves and underleaves 2-lobed, underleaves usually also ciliate or toothed ..... ***Chandonanthus squarrosus***
Stems variously coloured, lacking paraphylls; leaves variously lobed 6

6 Leaves divided to beyond half way 7
Leaves not divided beyond half way 9

7 Leaves divided into 3–4 narrowly triangular lobes, usually with 2 extra teeth on the side; lobes spreading away from stem ..... ***Temnoma palmatum***
Leaves divided into 4 long narrow lobes; lobes parallel to stem 8

8 Leaf lobes spine-like, bent in centre; leaves succubous ..... ***Psiloclada clandestina***
Leaf lobes narrowly to widely triangular; leaves ± transverse ..... ***Kurzia***

9 Underleaves always joined to leaves on both sides, usually strongly ..... ***Heteroscyphus***
Underleaves joined to leaves on 1 side only, or not joined at all 10

10 Leaves with irregular fragile teeth on margin, often broken off, giving leaves a ragged appearance; cuticle with a distinct rainbow sheen ..... ***Leptophyllopsis laxa***
Leaves without such marginal teeth; cuticle without a distinct rainbow sheen 11

11 Leaves ± transverse, 4-lobed to almost half way; stolons present; rare plant of subalpine woodland ..... ***Pseudocephalozia paludicola***
Leaves clearly succubous, not deeply 4-lobed; stolons not present 12

12 Sporophyte developing in perianth on short lateral branch; underleaves usually joined to leaves on 1 side, sometimes narrowly; leaves ± circular to tongue-shaped ..... ***Chiloscyphus***
Sporophyte developing in marsupium on short branch on underside of stem; underleaves clearly not joined to leaves; leaves various 13

13 Leaves ± oblong, deeply lobed at apex; underleaves divided to the base into 2 diverging lobes* ..... ***Geocalyx calcdonicus***
Leaves ± triangular-ovate, entire or very shallowly lobed at apex; underleaves almost circular, shallowly notched at apex ..... ***Saccogynidium***

* Species of *Lophozia*, a genus not yet formally reported for Victoria but undoubtedly present here, could key out at couplet 13.

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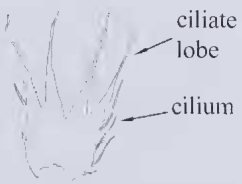
Glossary of liverwort terms

Alternate With branches alternating from one side to another along stem or thallus, so that the branches are not opposite.

Bipinnate Branched pinnately, and each branch also branched pinnately.

Ciliate With long hair-like processes (cilia).



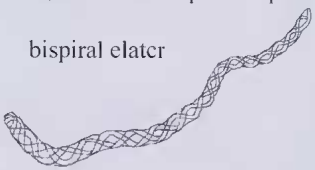
Complicate-bilobed Consisting of two seemingly separate segments (lobe and lobule, or double lamina and keel), very different in their size and shape; the segments are joined, but sometimes very narrowly. See *keel*, *lobule*.

Dissected Notched at the apex; if the notch is so deep that the two sides touch or overlap at their tips, then the term 'deeply dissected' is used.

Dioecious Having the male and female organs on separate plants.

Dorsal On the upper side of the thallus or shoot, i.e. farthest from the substratum.

Elater Elongated cell with spiral or bispiral internal structure, present in most liverwort and some hornwort capsules; involved in spore dispersal.



Entire Without teeth, spines or other projections (but may be lobed).

Epiphyllous Growing on the leaf or frond of another plant.

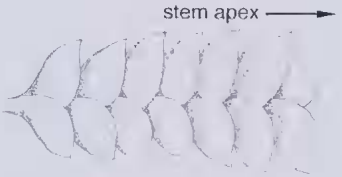
Epiphytic Growing on another plant (usually on bark).

Flagellum A ventral branch with minute leaves, usually anchoring the plant to the substratum.

Gemma A multicelled propagule capable of growing into a new plant; often formed in a specialised organ but also often arising from leaves, thallus margins or other plant parts.

Hyaline Transparent and colourless.

Incubous Arranged so that, when viewed from the dorsal side, each leaf overlaps the one nearer the stem apex (or would if they were close enough).



Intercalary branch A branch produced by an outgrowth from within the stem, rather than from the stem apex. Intercalary branches have a tiny